Yarmouk University
Faculty of Economics and Administrative Sciences
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Integration of Regional Stock Exchanges: Empirical Evidences from four Arab Countries (Jordan, Saudi Arabia, Kuwait, Bahrain).

التكامل بين البورصات الإقليمية: أدلة تجريبية من الدول العربية الأربع
(الأردن،السعودية، الكويت والبحرين)

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Master in the department of Banking and Finance, Yarmouk University, Irbid, Jordan

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الاهداء

الى من أحزنني فراقه صاحب الروح الطاهرة والنفس الزكية المحبة لجميع الناس الطموحة الى ابعد الحدود.

أهدي هذه الرسالة الى أعز الناس الى قلبي، لكي أحقق له ما كان يصبو الى تحقيقه ولكن القدر لم يمهله، ليتم ما بدأه وهو الحصول على درجة الماجستير. حيث اختاره الرفيق الأعلى بعد شوط قصير في دراسة الماجستير، لذا أقدم هذه الرسالة هدية واصلة الى روح أخي الغالي محمّد الابراهيم المتوفى في 2009/12/3.

اللهم اغفر له وارحمه وادخله فسيح جناته في الفردوس الأعلى

والهمنا من بعده الصبر والسلوان على فراقه

آمين

الباحث: سيف أحمد الإبراهيم

الشكر والتقدير

بعد شكر الله عز وجل والصلاة على النبي (صلى الله عليه وسلم) أتوجه بالشكر للأستاذ الدكتور سعيد الحلاق (مدير مركز الملكة رانيا) لاشرافه على رسالتي، كما أتوجه بالشكر للدكتور محمد العجلوني (نائب عميد كلية الاقتصاد والعلوم الادارية) على توجيهه ومساعدته خلال إعداد الرسالة.

كما أتقدم بالشكر والتقدير الى أعضاء لجنة المناقشة: الأستاذ الدكتور علي مقابلة (رئيس قسم العلوم المالية والمصرفية) و الأستاذ الدكتور وليد حميدات (عميد كلية الاقتصاد والعلوم الادارية).

كما أتقدم بشكري الى زميلي الدكتور أحمد المجالي/البنك المركزي على مساعدته لي في التحليل، وإلى والدي الذي لم يتوانى عن دعمه المتواصل لي.

الباحث: سيف أحمد الإبراهيم

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List of Abbreviations

ADF	Augmented Dickey-Fuller
ASE	Amman Stock Exchange
BSE	Bahrain Stock Exchange
KSE	Kuwait Stock Exchange
CAPM	Capital Asset Pricing Model
CMD	Campbell-Mankiw Decomposition
CVR	Cochrane Variance Ratio
DF-GLS	Modified Dickey-Fuller
GCC	Gulf Cooperation Council
MENA	Middle East and North Africa
OECD	Organization for Economic Co-operation and Development
PP	Philips-Perron
SESMs	Smaller European Stock Markets
SSE	Saudi Arabia Stock Exchange
VAR	Vector Autoregressive

Abstract

Integration of Regional Stock Exchanges: Empirical Evidences from four Arab Countries (Jordan, Saudi Arabia, Kuwait, Bahrain).

By: Saif Ahmed Al-Ibrahim

Supervisor: Prof. Said Alhalaq

This study investigates the relationship between Amman Stock Exchange (ASE) and three markets in the region. These are Saudi Arabia Stock Exchange (SSE), Kuwait Stock Exchange (KSE), and Bahrain Stock Exchange (BSE) markets, for or the period from January 1st, 2003 through December thirty 1st, 2007.

Jordanian stock market, which became one of major stock markets in the region, plays an important impact on global investments for portfolios diversifications and for economic stability.

The preliminary analysis of unit root tests, the Augmented Dickey-Fuller (ADF) test and Philips-Peron (P-P) test show that the data

are stationary.

The empirical analysis rejects the hypothesis of no cointegration between ASE and SSE, KSE and BSE, which mean that the four regional stock exchanges are integrated, by using Johansen Cointegration Test. Also the results indicate that ASE is bilaterally cointegrated with these regional markets. It implies that there is a little risk diversification to be gained in investing more than one of these markets, since they are driven by the same factors. So, it recommended that Jordan should thus continue enhancing the transparency and the effectiveness of regulation and supervision of its capital markets so as to distinguish itself further from other markets.

Keyword: Financial Market Integration, Portfolio Diversification, Cointegration Test, ASE, SSE, KSE, BSE.

ملخص

التكامل بين البورصات الإقليمية: أدلة تجريبية من الدول العربية الأربع (الأردن،السعودية، الكويت والبحرين)

إعداد: سيف أحمد الإبراهيم

بإشراف: الأستاذ الدكتور سعيد الحلاق

تتناول هذه الدراسة العلاقة بين سوق عمان المالي (ASE) وأسواق السعودية المالي (SSE)، الكويت المالي (KSE)، البحرين المالي (BSE). للفترة من 1 يناير 2003 حتى 31 ديسمبر 2007. سوق عمان المالي – والذي أصبح واحد من الأسواق الرئيسية في المنطقة – له تأثير هام في تنويع المحافظ الاستثمارية وتحقيق الاستقرار الاقتصادي. بين التحليل الأولي من خلال تطبيق Unit Root Tests، Augmented Dickey-Fuller (ADF) test and Philips-Peron (P-P) test أن البيانات ثابتة. كما أن التحليل يرفض عدم التكامل المشترك (cointegration) بين بورصة عمان وتلك البورصات الثلاث، الأمر الذي يعني أن أربعة من الأسواق الإقليمية العربية، هي الأردن والسعودية والكويت البحرين، متكاملة. باستخدام Johansen Cointegration Test. كما تشير النتائج الى أن بورصة عمان هي ثنائية التكامل مع تلك الأسواق الإقليمية. مما يعني أن هنالك القليل من تنويع المخاطر التي يمكن الحصول عليها في حالة الإستثمار في أكثر من أحد هذه الأسواق او كونها مرتبطة بنفس العوامل. وتوصي الدراسة باستمرار سوق عمان المالي بتعزيز الشفافية والتنظيم والاشراف، ليتميز عن مزيد من الأسواق.

كلمات رئيسية: تكامل الأسواق المالية، تنويع المحفظة، اختبار التكامل المشترك، بورصة عمان، بورصة السعودية، بورصة الكويت، بورصة البحرين.

Chapter One

General Framework

Chapter One

General Framework of the Study

(1-1) Preface

In recent years, globalization, economic openness and diversification among countries and their financial markets increased among stock markets. That helps the global investors for their asset allocation decisions. Hence, there is a need to study the extent of integration among the world stock markets. Given the Jordanian stock exchange suitable environment for global and gulf investors. The research aims at investigating whether Arab regional stock exchanges are integrated. The samples of this thesis include:

1-Amman Stock Exchange (ASE)

2-Saudi Arabia Stock Exchange (SSE)

3-Kuwait Stock Exchange (KSE)

4-Bahrain Stock Exchange (BSE)

This thesis is interested in analyzing the performance of the Amman Stock Exchange (ASE) market and its integration with other markets in the region (Saudi Arabia stock exchange (SSE), Kuwait stock exchange (KSE), and Bahrain stock exchange (BSE)). Using cointegration technique -Johansen's maximum likelihood estimator- to identify these potential long-run relationships.

(1-2) Objective of the Study

The purposes of this study as follow:

- To investigate the relationship between ASE with other markets in the region. These are (SSE, KSE & BSE).
- To show the impact of such correlation on portfolio diversification and attractive Arab investors to ASE.
- To specify the diversification benefits to the Arab investors that will generate by investing abroad.

(1-3) Problem of the Study

The dream of regional stock market in ARAB has not come to fruition, and we start from four countries. Recently, financial market liberalization and rapid development of telecommunications networks has increased significantly the ability to transmit and disseminate information between markets. From the fact that these markets present portfolio and fund managers a new possibility to enhance and optimize their portfolios, and the fact that the Gulf Cooperation Council (GCC) have traditionally discriminated against non-GCC investors, but ASE is largely open to foreign investors. These markets offer capital-rich GCC equity investors unique diversification benefits associated with optimum portfolios with a balanced mix of domestic and international securities. The issue of cointegration between Amman Stock Exchange (ASE) and other markets in the region appear.

(1-4) Importance of the Study

Jordanian stock market, which became one of major stock markets in the region, plays an important impact on global investments for portfolios diversifications and for economic stability. For instance, the degree of benefits attainable by foreign individual portfolio investment depends on the diversification of the portfolio, which depends on the degree of market risk which cannot be eliminated locally.

(1-5) Hypotheses of the Study

The objectives of this study can be achieved by testing the following main hypothesis:

"There is no co-integration between ASE and regional stock markets."

This hypothesis can be broken into three sub-hypotheses. They are:

H_1: there is no co-integration between ASE market and SSE.

H_2: there is no co-integration between ASE market and KSE.

H_3: there is no co-integration between ASE market and BSE.

(1-6) Data and Methodology of the Study

(1-6-1) Data of the Study

The data that will be used in this study consists of monthly closing prices of the weighted indices for each of Amman Stock Exchange (ASE), Saudi Arabia Stock Exchange (SSE), Kuwait Stock Exchange (KSE) and Bahrain Stock Exchange (BSE) markets, for the period from January 1, 2003 through December 31, 2007. From which the monthly rates of returns will be calculated as the first in the logarithmic closing prices for the period. The data were used obtained from secondary sources.

(1-6-2) Methodology of the Study

We will use co-integration techniques proposed by Johansen (1991) to analyze data by using Econometric Views (E-views). To achieve the objectives of this study and examine the main hypothesis and sub-hypotheses.

(1-8) Organization of the Study

The thesis consists of six chapters as follows:

This chapter (chapter one) provide general framework of the study. Chapter two presents the literature review related to the study. Theoretical framework of the study presented in chapter three. Data and methodology of the study are outlined in chapter four. The analysis is presented in chapter five. Finally, chapter six provide conclusions and recommendations.

Chapter Two

Literature Review

Chapter Two

Literature Review

(2-1) Introduction

Various studies are undertaken in different parts of the world regarding integrations among stock markets by many researchers. Recent advances in time series analysis allow investigation of long run equilibrium among stock markets using the methods of cointegration. Some important ones are reviewed in this chapter as follows:

(2-2) Arabic Studies

Two main investigations interested in the regional stock markets were published recently, **Gunduz and Omran (2001)** studied the hypothesis of common stochastic trends among the markets of Turkey, Israel, Egypt, Morocco, and Jordan over the period 1997–2000 of a log of weekly stock indices. The individual stochastic investigation is conducted by means of the Augmented Dickey-Fuller (ADF) tests, the Philips-Perron (PP) test, the

Modified Dickey-Fuller (DF-GLS), the KPSS test, the Cochrane Variance Ratio (CVR) test and the Campbell-Mankiw Decomposition (CMD) test. Results from all five tests indicate that all five series seem to contain a stochastic trend and thus are nonstationary in levels. Presence of a unit root implies that shocks to stock prices are permanent and consequently, stock prices may not be predictable. This first generation of empirical investigations suggested overall that, though the Middle East and North Africa (MENA) capital markets still appear to be segmented from one another, they seem individually integrated to global markets through stable bivariate long-run relationships.

Neaime (2002) investigated a mix of Middle East and North Africa (MENA) and Gulf Cooperation Council (GCC) countries—Egypt, Jordan, Morocco, Turkey, Bahrain, Kuwait, and Saudi Arabia—from 1990 to 2000. It also explores whether these markets can offer international investors unique risk and returns characteristics to diversify international and regional portfolios. Johansen cointegration tests reveal that the GCC equity markets

still offer international investors portfolio diversification potentials while other emerging MENA stock markets like those of Turkey, Egypt, Morocco and to a lesser extent Jordan have matured and are now integrated with the world financial markets. He found that, unlike the GCC markets, which remained segmented, financial integration of the MENA markets seemed to go along with a strong sensitivity to unidirectional shocks flowing from the United States and United Kingdom. However, he found no evidence of intraregional financial integration.

(2-3) English Studies

Fischer and Palasverta (1990) used cross-spectral analysis to test for interdependence between stock market indices of 23 countries to support or reject the hypothesis that the world markets becoming more integrated in the period from 1986-1988. They further found that the US index prices lead almost every country index in the sample.

Chan *et al.* (1992) used unit root and co-integration tests to examine the relationships among the stock markets in Hong Kong,

South Korea, Singapore, Taiwan, Japan, and the United States. Their findings suggest that the stock prices in major Asian markets and the United States are weak-form efficient individually and collectively in the long run.

As **Kasa (1992)** presented the number of common stochastic trends in the US, Japan, Germany, and Canada. Monthly and quarterly data (from January 1974 to August 1990) are used. He pointed out that stock markets that are co-integrated have a long-run relationship, so long-run correlations of returns are higher than short-run correlations typically examined. If (n) variables have (p) co-integrating relationships, they have n – p common trends. When n – p = 1, as in the case of the five developed-country (US, Japan, England, Germany, and Canada) stock indices investigated, correlations of returns converge to unity and there is no diversification potential in the long-run. In this situation, the individual stock markets are completely and perfectly integrated. The results indicate the presence of a single common trend

driving these countries stock markets and this trend is most important in the Japanese market and least important in the Canadian market.

Chung and Liu (1994) investigated the cointegration of U.S., Japan, Taiwan, Hong Kong, Singapore, and South Korea stock exchanges. Using weekly data denominated in local currencies over the period January 7, 1985 to May 18, 1992. They found 1, 2, and 4 co-integrating vectors in models with 12, 24, and 36 lags, respectively, noting that "the number of co-integrating relationships is sensitive to the choice of lag length. After inspection of each model's forecasting performance (rather than inspection of the lag structure), they settled on the model with 24 lags and two co-integrating vectors.

Markellos and Siriopoulos (1997) examined the diversification benefits available to the U.S. and Japanese investors over the period 1974 - 1994 in seven smaller European stock markets (SESMs): Austria, Belgium, Greece, Holland, Ireland, Italy, and

Spain. With reference to a simplified international CAPM that accommodates both contemporaneous and delayed information flows, he employed correlation, principal components, and cointegration analysis in studying monthly observations from national basket indices. The empirical evidence is conclusive in showing that the SESMs have behaved differently, at least since the October 1987 crash, with stronger contemporaneous interdependencies and integration between them and with the U.S market. Cointegration analysis found no significant common trend shared between the SESMs and the U.S and Japanese markets. They concluded that despite the increasing international integration there still exist opportunities for diversification investment in the smaller and less studied European stock markets.

Liu *et al.* (1998) examined the stability of the interrelationship among the emerging and developed stock markets of Thailand, Taiwan, Japan, Singapore, Hong-Kong and the US. Weekly data stock price indices based on local currencies are used during the

period from Jan.7, 1985 to May 18, 1992. Through Johansen's maximum likelihood estimation procedure, two cointegration relationships are identified and six stock price variables are found to share four common unit roots. They found an increase in the general stock market interdependence.

Masih and Masih (1999) used daily data over February 14, 1992 to June 19, 1997 denominated in real US dollars (although they do not explain the conversion to real values for daily data) they found cointegration in a block of Organization for Economic Co-operation and Development (OECD) and Asian countries including the United States, Japan, UK, Germany, Singapore, Malaysia, Hong Kong, and Thailand, but concluded that there is at most one cointegrating vector, leaving seven independent common stochastic trends.

Sheng and Tu (2000) used a co-integration and variance decomposition analysis to examine the linkages among the stock markets of 12 Asia- Pacific countries, before and during the period of the Asian financial crisis. The data consist of daily

closing prices for the New York index and the following 11 major Asia-Pacific equity market indices: Tokyo, Hong Kong, Singapore, Sydney, Seoul, Taiwan, Kuala Lumpur, Manila, Bangkok, Jakarta and Shanghai. The data divided into two groups:

1. July 1, 1996-June 30, 1997: the period before the crisis.
2. July 1, 1997-June 30, 1998: the period during the crisis.

Johansen's multivariate cointegration and error-correction tests provide evidence to support the existence of at least one cointegrational relationship among the national stock indices during the period of the financial crisis. The relationship for the South-East Asian countries was stronger than that for the North-East Asian countries. The tests also showed no cointegrational relationship before the period of the financial crisis. The forecast error variance decomposition also found that the degree of exogeneity for all countries indices has been reduced, implying that no countries are 'exogenous' to the financial crisis.

Chen, Firth, and Rui (2002) applied cointegration analysis and error correction vector autoregressions (VAR) techniques to model the interdependencies to study integration among Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela over the period 1995–2000 and found that there is generally just one cointegrating vector which appears to explain the dependencies in prices. The results are robust to sensitivity tests based on translating indexes to US dollars (i.e., a common currency for all the markets) and to partition the sample into periods before and after the Asian and Russian financial crises of 1997 and 1998, respectively. Their results suggested that the potential for diversifying risk by investing in different Latin American markets is limited.

Sharma and Wongbangpo (2002) examined monthly data (from January 1986 through December 1996) for the ASEAN-5 markets denominated in local currencies. They found a long-run cointegrating relationship among the stock markets of Indonesia, Malaysia, Singapore, and Thailand, but concluded that the

Philippine market does not share the relationship. Furthermore, there is only one cointegrating vector among the four markets, leaving three common trends. One particularly interesting finding is that Malaysia and Singapore move together one-for-one in the cointegrating vector, ostensibly because of the distribution of inward foreign direct investment flows, the strength of trade between the two economies, the geographical proximity, and cultural factors.

Johnson and Soenen (2002) found that the equity markets of Australia, China, Hong Kong, Malaysia, New Zealand, and Singapore are highly integrated with the stock market in Japan, by using daily returns from 1988 to 1998. There is also evidence that these Asian markets become more integrated over time, especially since 1994. A higher import share as well as a greater differential in inflation rates, real interest rates, and gross domestic product growth rates have negative effects on comovements between country pairs. Conversely, increased export share by Asian economies to Japan and greater foreign direct investment from

Japan to other Asian economies contribute to greater comovement. **Click and Plummer (2005)** demonstrated that the stock markets of ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, and Thailand) in the period after the Asian financial crisis (July 1, 1998 through December 31, 2002) are cointegrated using the time series technique of cointegration to extract long-run relations, whether analyzed using daily data or weekly data, and weather analyzed in local currencies, the US dollar, or the Japanese yen. However, they concluded that ASEAN-5 stock markets are integrated in the economic sense, but that integration is far from complete, and benefits of international portfolio diversification across the five markets from the perspective of the international portfolio investor are reduced but not eliminate.

(2-4) Summery of Previous Studies

Most of the studies mentioned above used unit root and cointegration tests to examine the relationships among the stock markets between different countries. Like these studies, the current study aims to investigate the long-run relationship between markets by employing cointegration techniques and unit root test.

This study complements the two previous studies that were interested in the regional stock markets. It extends the works done by both Gunduz and Omran (2001) and Neaime (2002) which studied the period until the year 2000. This study is distinguished from previous studies in that it uses monthly data basis instead of weakly or daily basis.

Chapter Three

Theoretical Framework

Chapter Three

Theoretical Framework of the Study

(3-2) Introduction

Individuals and firms who have incomes those are greater than their current expenditure, so they have funds available to invest. Modern portfolio theory defined investment as the current commitment of these funds for a period of time to derive a rate of return that compensates for the time involved, the expected rate of inflation, and the uncertainty of the future payments.

The uncertainty of the payments from an investment is the investment risk. Investment risk related to the probability of actual earning less than the expected return, the greater chance of low or negative returns, the riskier the investment.

Most financial institutions are holding an investment, whether a stock, bond, or other assets, as part of a portfolio because generally it is less risky than holding the same investment all by it

self. Banks, pension funds, insurance companies, and mutual funds are required by law to hold diversified portfolios. Even individual investors–at least those whose security holdings constitute a significant part of their total wealth–generally hold stock portfolios, not the stock of only one firm. If investors want o diversify their portfolios and reduce risk, they want an investment that has either low positive correlation, zero correlation, or negative correlation with other investments in their portfolios.

By diversification we can reduce risk, but not eliminate it. Then the part of a stock's risk that can be eliminated locally is called diversifiable or unsystematic, risk; the part cannot be eliminated locally is called nondiversifiable, or systematic risk. Investors, then, invest abroad their countries into ASE, SSE, KSE, and BSE markets.

(3-2) Market Establishment

Since the establishment of Jordanian capital market in 1978, the oldest capital market in the region refers to Kuwait, where Saudi capital market established in 1984, and the recent capital established in Bahrain at 1989 (as markets websites).

(3-3) Market Performance

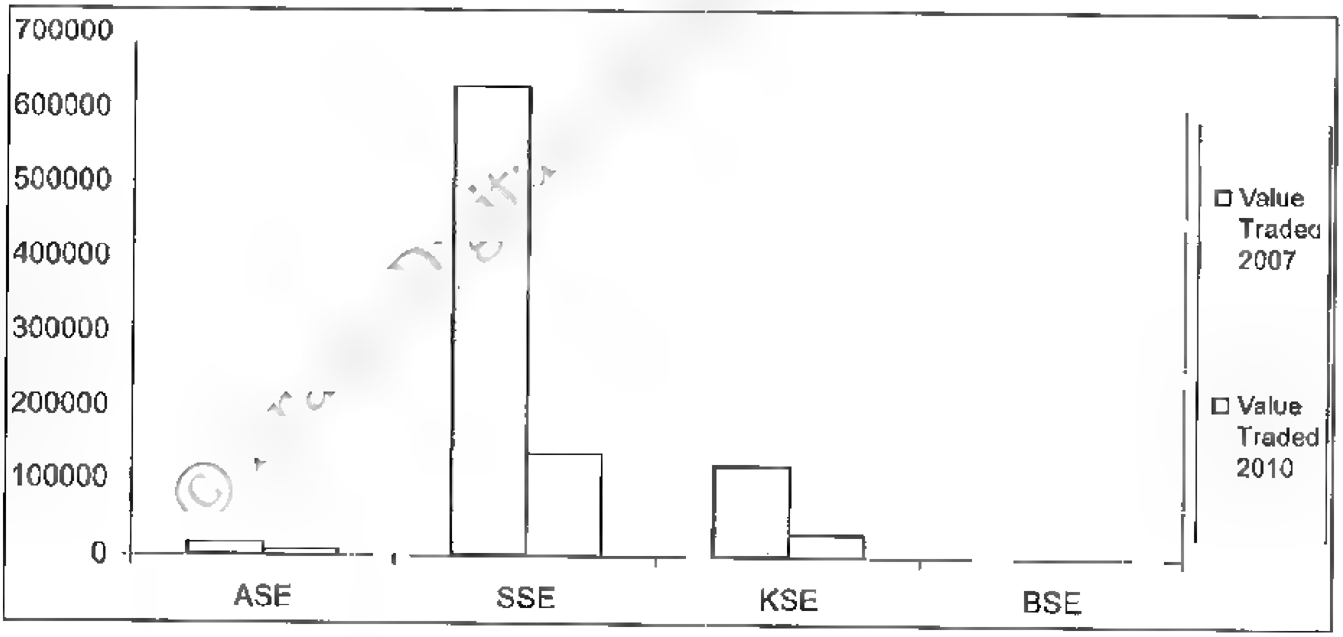
The increase of index for each of (ASE, SSE, KSE and BSE) from the beginning of 2003 and the end of 2007 as follows (335.5 percent, 322.7 percent, 419.27 percent and 163.03 percent) respectively (author calculation depends on appendix 1).

The best performance for (ASE, SSE, KSE and BSE) as follows: (November 30, 2005, January 31, 2006, December 31, 2006 and December 31, 2007) respectively.

(3-4) Value Traded

As figure (3-1) the value traded at 2007 reached US 17.1 billion, US 628.1 billion, US 120.7 billion and US 0.8 billion, for ASE, SSE, KSE and BSE, respectively.

Figure (3-1) value traded in US millions at 2010 compared with 2007.



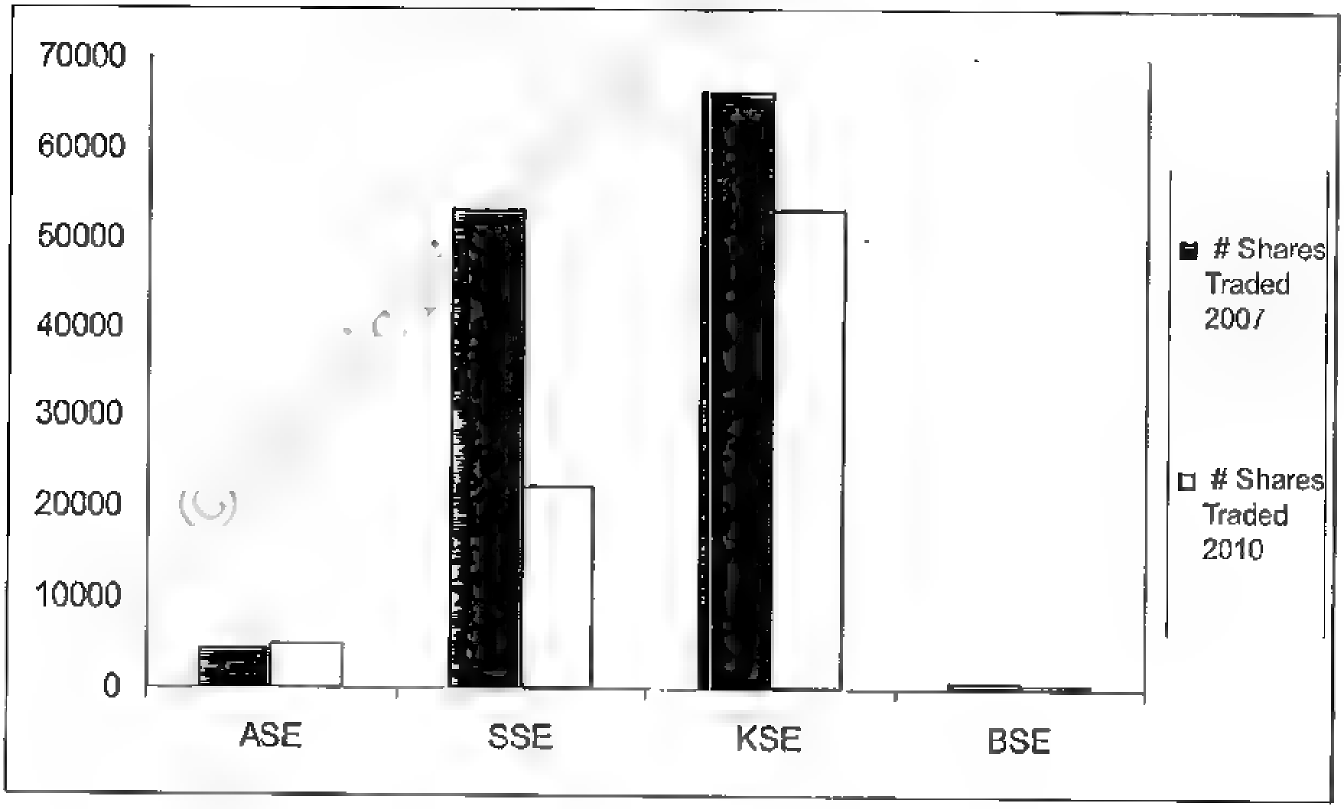
Source: Author's Calculation based on Appendix I.

As shown from figure (3-1), the percentage decreased value traded for each of (ASE, SSE, KSE and BSE) from 2007 to 2010 as follows ((60.4) percent, (75) percent, (76) percent and (78.6) percent) respectively.

(3-5) Number of Shares Traded

As figure (3-2) the shares traded at 2007 reached US 4.4 billion, US 53.1 billion, US 66.6 billion and US 0.7 billion, for ASE, SSE, KSE and BSE, respectively.

Figure (3-2) # of shares traded in US millions at 2010 compared with 2007.



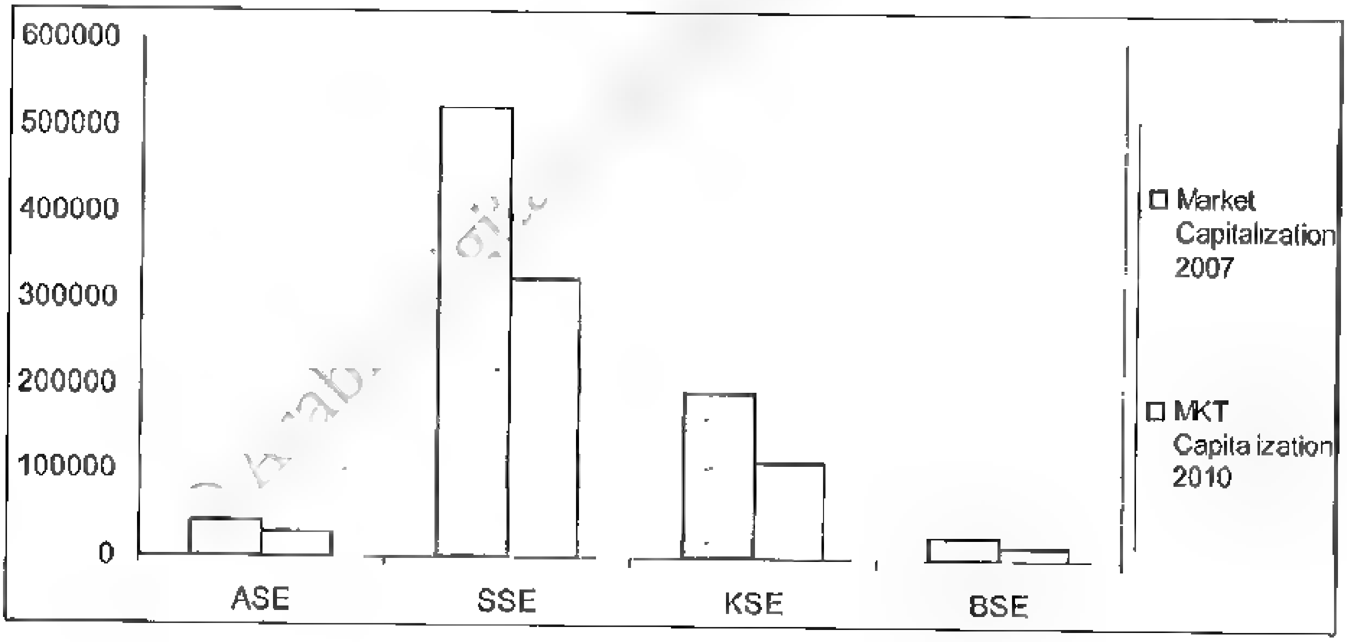
Source: Author's Calculation based on Appendix I.

As shown from figure (3-2), all markets the number of shares traded decreased except ASE market.

(3-6) Market Capitalization

Figure (3-3) shows the largest market capitalization in the region for SSE that at 2007 reach US 522.7 billion then KSE around US 193.5, and smallest for BSE by US 26.8, where the ASE market capitalization has a medium size in the region.

Figure (3-3) market capitalization US millions at 2010 compared with 2007.



Source: Author's Calculation based on Appendix1.

As shown from figure (3-1), all market capitalization for each of (ASE, SSE, KSE and BSE) decreased from 2007 to 2010 as follows ((31.8) percent, (39.6) percent, (42.5) percent and (37.9) percent) respectively.

(3-7) Number of Listed Companies

The ASE has a biggest number of listed companies in the region (281), then KSE about (224), and the smallest is BSE by only (52), and SSE has a medium number of companies listed by (142) company.

Chapter Four

Data & Methodology

Chapter Four

Data & Methodology of the study

(4-1) Data of the Study

The data consists of monthly closing prices of the weighted indices for each of Amman Stock Exchange (ASE), Saudi Arabia Stock Exchange (SSE), Kuwait Stock Exchange (KSE) and Bahrain Stock Exchange (BSE) markets, for the period from January 1, 2003 through December 31, 2007.

This study uses monthly indices instead of daily indices to avoid biases that could result from non-trading days, non-synchronous trading hours and days, and to avoid the noise commonly associated with daily data. In addition, we use the end of month indices to avoid day-of-the-weak effects for stock returns. If we take data on daily basis the number of observations will differ specifically Saudi Arabia market will differ so far from others markets because it close only on Friday. The indices themselves,

dominated in local currencies. In this study, we analyze indices in local currency. The distinction between local currency comparisons and common currency comparisons deserves some discussion. This is a comparison of dissimilar units (currencies), and if the units themselves behave differently (as would be the case when inflation rates are different across currencies or when real exchange rate changes alter the relative values of currency units) then conclusions may not be valid. As pointed out by Click and Plummer (2005), there are pros and cons for using the stock indices measured in local currency terms or in a common currency (U.S. dollars). Local currency indices are preferred for analyzing the behavior of the local currency indices themselves. The common currency series implicitly represent the sum of the returns on two assets: the domestic stock index and the domestic currency. Thus, the behavior of the exchange rate could offset variations in the domestic stock market and thus mask the underlying behavior of the domestic market.

(4-2) Methodology of the Study

(4-2-1) Unit Root Test

Regressing non-stationary variables on each other leads to potentially misleading inferences about the estimated parameters and the degree of association. Therefore, before testing for cointegration, the order of integration of stock prices must be determined.

A unit root test is used to test a time series for stationary. To test for a unit root (or the difference stationary process), we employ both the Augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979) and the Phillips–Perron (P–P) test (1988).

(a) Augmented Dickey–Fuller regression:

$$\Delta x_t = p_0 + p x_{t-1} + \sum_{i-1}^{n} \sigma_i x_{t-i} + \varepsilon_t \qquad (2)$$

(b) Phillips–Perron regression:

$$x_t = \alpha_0 + \beta x_{t\_1} + u_1 \qquad (3)$$

The conversion to a common currency also raises the possibility that the converted indices may uncover some behavior because of the behavior of the common currency, such as a depreciation of the dollar against all other currencies, although this concern is less significant for a stable currency. Click and Plummer (2005).

From the monthly closing prices, the monthly rate of return will be calculated as follows:

$$R_t = \frac{(\log P_t - \log P_{t-1})*100}{\log P_{t-1}} \qquad (1)$$

Where:

R_t: is the return index at time t.

P_t: is the closing index price at the current month.

P_{t-1}: is the closing index price at the previous month.

log: logarithm

Quantitative data (indices) for the analysis purpose and qualitative data for theoretical framework obtained from secondary sources (markets and Arab Monetary Fund websites).

The difference between the two unit root tests lies in their treatment of any 'nuisance' serial correlation. The P–P test tends to be more robust to a wide range of serial correlations and time-dependent heteroskedasticity.

(4-2-2) Short-Run Correlations

The correlation coefficient measures the direction and the degree of the relationship between two variables. Thus, Pearson correlation is used to find correlation between the four stock markets under study.

(4-2-3) Cointegration Test

Cointegration is a property of two or more variables moving together through time. This study use co-integration techniques proposed by Johansen (1991) to identify potential long-run relationships between Arab stock markets. We interpret the co-integrating relationship as the long-run relationship between the stock market prices.

In simple terms, this methodology can be described as follows. Define a k-vector of nonstationary $I(1)$ variables X_t (stock market price indices); and assume the vector has a vector autoregressive (VAR) representation of the form:

$$X_t = A_t X_{t-1} + \ldots + A_\varepsilon x_{t-p} + \mu + t \quad (4)$$

Where

εt is a vector of innovations. The above equation can be reparameterized as follows:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-i} \Gamma_i \Delta X_{t-i} + \mu t + \varepsilon t \quad (5)$$

Where :

$$\Pi = \sum_{i=1}^{p} A_i - I, \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

The presence of cointegrating relationships is indicated by the rank of (Π) that is the number of cointegrating relationships. Following Chen et al. (2002) and Click and Plummer (2005). If k variables have r co-integrating relationships, which determine the long-run equilibrium relationship between the variables, then they

have k-r = n common stochastic trends. Theoretically, there are three scenarios depending on the rank of Π:

(i) Π could have rank zero (r=0), which implies there is no stationary long-run relationship among the elements of Xt, and thus equation (5) reduces to a standard VAR in first differences. In this case, the stock markets are not co-integrated. In an economic sense, this implies that the stock markets are segmented; that is, they are behaving quite differently and diversification amongst these markets would be beneficial.

(ii) Π could be of full rank (r=k). In this case, the assumed stationarity of the error terms requires that the levels of the Xt process themselves be stationary, implying the absence of any stochastic trends whatsoever in the data, and contrary to the original nonstationary I(1) specification. This implies that the technique of co-integration is inappropriate. Such a result would be highly unusual for financial variables, which tend to be nonstationary.

Chapter Five

Analysis of the Study

(iii) Π could be of rank r ($0 < r < k$), then there exist (kxr) matrices α and β each with rank r such that $\Pi = \alpha\beta$ and βX_t is $I(0)$. The number of co-integrating relationships is r (the co-integration rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the vector error correction model.

Johansen's method consists in estimating the matrix Π from an unrestricted VAR and testing whether we can reject the restrictions implied by the reduced rank of Π .The existence of cointegrating relationships among the variables can be determined by two tests proposed by Johansen: the trace and the maximum-eigenvalue tests. In practice, the tests are implemented by first testing the null hypothesis of $r=0$ (no co-integration), and then if it is rejected, testing $r=1$, and so on.

Chapter Five

Analysis of the Study

(5-1) Introduction

The purpose of this section is to investigate the relationship between ASE and other Arab markets in the region. These are SSE, KSE & BSE. First, we present the descriptive statistics of stock market returns. Second, we present short run correlations. Third, we present long-run relationships, that is, we investigate whether ASE and other stock markets in the study are integrated with each other. Before make the examination of cointegration tests; we make sure that the data is stationary or not.

(5-2) The Data

This section considers the empirical characteristics of the ASE index together with those of selected regional Arab markets. The researcher used monthly prices of the weighted indices of the

markets from January 1, 2003 to December 31, 2007. Table 5-1 shows summery statistics of the monthly stock index returns in the four countries, namely sample means, medians, minimums, maximums, standard deviations, variances, means to standard deviations and numbers of observations.

Table 5-1. Descriptive Statistics-monthly Stock Index Return of the 4 exchanges during the period 1/1/2003 – 31/12/2007.

Symbol	Mean	Median	Max.	Min.	Std. Dev.	Var.	Mean/Std. Dev	# of observes
ASE	2.77	2.05	23.56	-12.48	7.23	52.21	0.38	59
BSE	1.71	1.16	9.69	-5.63	3.5	12.24	0.01	59
KSE	3.74	3.29	98.27	-45.41	15.09	227.72	0.25	59
SSE	2.89	4.03	15.82	-23.55	9.08	82.36	0.32	59

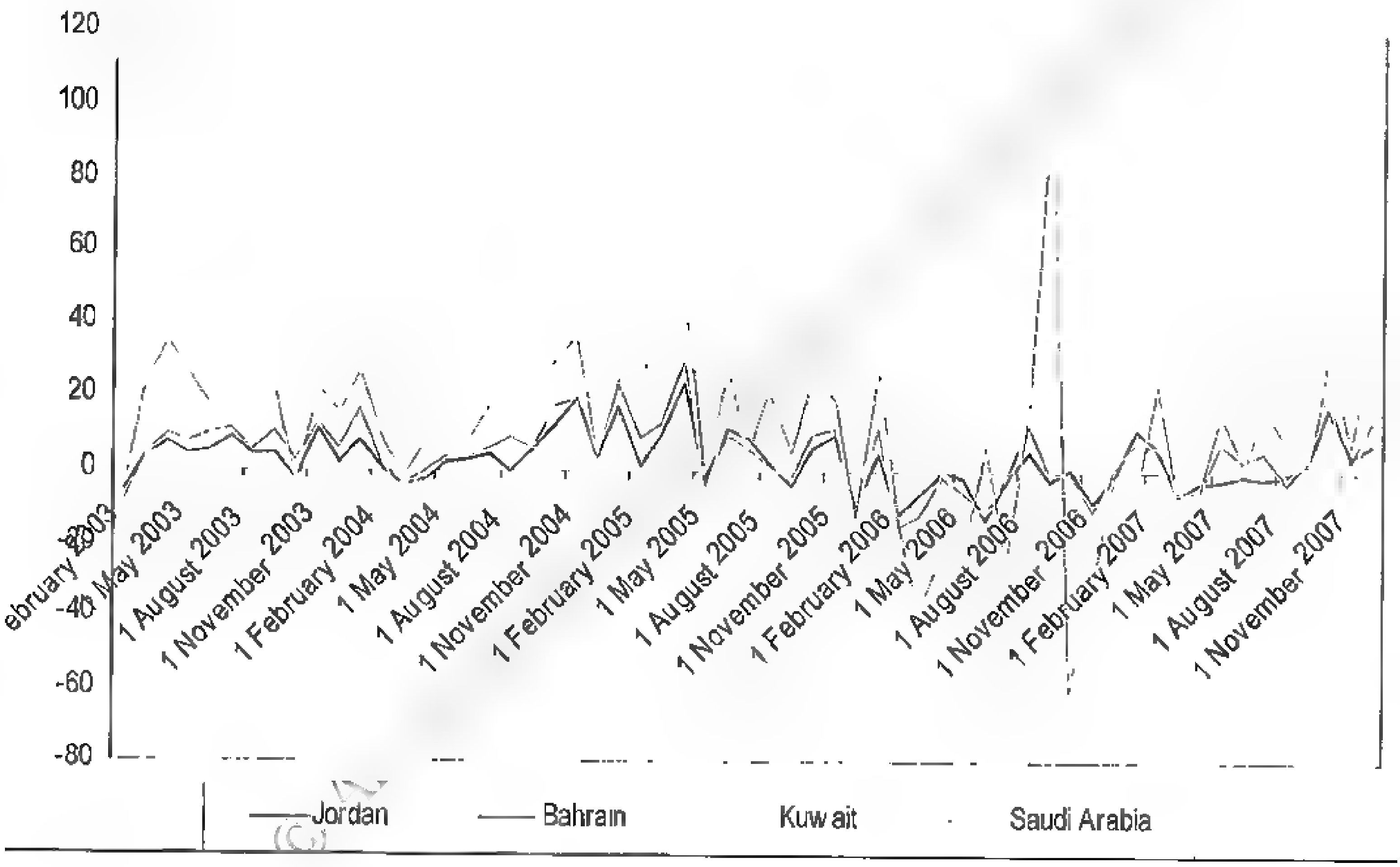
Source: Author's Calculation based on Appendix A1.

The average monthly return for the KSE is high compared with other countries over the period covered by this study. However, in terms of risk, the standard deviation of returns also high compared with other countries.

The recent boom in stock markets is regional phenomenon. All stock markets in this study have seen heavy inflows recently which

have pushed the key indices to levels suggesting a bubble to some observes; figure 4-1 show the four indices returns time series for the whole period of the study.

Figure 5-1. Trend of the 4 monthly indices returns over the period 1/1/2003 - 31/12/2007.



Source: Author's Calculation based on Appendix1.

(5-3) Short-Run Correlations

Modern portfolio theory recommends that stock portfolios be diversified to reduce systematic local risk because the correlation between markets is not perfect. Thus, as the returns of different stock markets do not move together investors can reduce risk or increase returns through international diversifications.

Table 5-2 presents the simple correlation coefficients among four stock markets under study.

Table 5-2. Short-run correlation between monthly stock indices returns during the period 1/1/2003 – 31/12/2007.

Symbol	ASE	BSE	KSE	SSE
ASE	1	0.3018	0.0609	0.3364
BSE	0.3018	1	0.1845	0.2179
KSE	0.0609	0.1845	1	0.1660
SSE	0.3364	0.2179	0.1660	1

Source: Author's Calculation based on Appendix A1.

It can be clearly seen from above that correlations among the returns of markets are low. The highest correlation is among Jordanian Stock Market and Saudi Arabia Stock Market (over

33%) and the lowest correlation between Jordanian Stock Market and Kuwait Stock Market (about 6%). It must also be pointed out that the KSE shows low correlations with all other markets.

(5-4) Unit Root Test

To test the presence of unit root in the data, i.e. to see whether it is stationary or non-stationary, this study uses Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. Table (5-3) shows the unit root test for returns of indices of ASE, SSE, KSE and BSE.

Table 5-3:

A. Augmented Dickey-Fuller (ADF test)

	Level			first difference		
Symbol	*t*-Statistic	Probability	Result	*t*-Statistic	Probability	Result
RASE	-6.17	0.0000	stationary	-9.65	0.0000	stationary
RBSE	-6.78	0.0000	stationary	-12.8	0.0000	stationary
RKSE	-9.99	0.0000	stationary	-8.13	0.0000	stationary
RSSE	-5.9	0.0000	stationary	-9.08	0.0000	stationary

*Mackinnon (1996) one-sided probability

B. Phillips-Perron (PP test)

Symbol	Level			first difference		
	t-Statistic	Probability	Result	*t*-Statistic	Probability	Resul
ASE	-6.42	0.0000	stationary	-24.54	0.0001	stationa
BSE	-6.8	0.0000	stationary	-22.47	0.0001	stationa
KSE	-12.94	0.0000	stationary	-75.97	0.0001	stationa
SSE	-6.08	0.0000	stationary	-19.61	0.0000	stationa

*Mackinnon (1996) one-sided probability

Table 5-3 shows that applying both unit root tests the returns of the four stock exchanges are stationary. This is shown by a negative *t*-statistics for ADF and PP tests.

(4-5) Cointegration Test

Cointegration is a property of two or more variables moving together through time. This study uses Johansen Cointegration Test to identify potential long-run relationships between regional stock markets.

(5-5-1) Bivariate Cointegration

We first ran bilateral cointegration tests to determine if the ASE is cointegrated with any of these regional markets (SSE, KSE and BSE). We performed two tests to detect a cointegration relation: the trace and the Maximum-Eigenvalue tests. We reject the hypothesis of no cointegration only if both tests reject the hypothesis, which is a more stringent criterion than normally applied. The results for bilateral cointegration are reported in Table 5-4, and show the evidence of cointegration.

Table 5-4, Bilateral Cointegration Results

		Trace test		Maximum Eigenvalue test	
Symbol	N0. of CE(s)	Trace statistic	probability	Max-Eigen statistic	probability
BSE	None (r=0)	34.59	0.0000	21.31	0.0000
	At most 1 (r≤1)	13.28	0.0003	13.28	0.0003
KSE	None (r=0)	55.28	0.0000	41.32	0.0000
	At most 1 (r≤1)	13.96	0.0002	13.96	0.0002
SSE	None (r=0)	46.47	0.0000	38.3	0.0000
	At most 1 (r≤1)	8.17	0.0043	8.17	0.0043

*MacKinnon-Haug-Michelis (1999) probabilities.

The results indicate that ASE is bilaterally cointegrated with those three stock exchanges, answer the three sub-hypothesis as follow:

(5-5-1-1) H_1: There is no cointegration between ASE & SSE

The co-integration between ASE and SSE results (table 4-4), the trace test, indicate that there exists co-integrating at the 5% level, and the Maximum Eigenvalue test also indicates the same result. Therefore, both tests indicate that ASE and SSE returns are trending together. So we reject this hypothesis of no cointegration between ASE and SSE.

(5-5-1-2) H_2: There is no cointegration between ASE & KSE

The co-integration between ASE and KSE results (table 4-4), the trace test, indicate that there exists co-integrating at the 5% level, and the Maximum Eigenvalue test, also indicates the same result. Therefore, both tests indicate that ASE and KSE returns are trending together. So we reject this hypothesis of no cointegration between ASE and SSE.

(5-5-1-3) H3: There is no cointegration between ASE & BSE

The co-integration between ASE and BSE results (table 4-4), the trace test, indicate that there exists co-integrating at the 5% level, and the Maximum Eigenvalue test, also indicates the same result. Therefore, both tests indicate that is, ASE and BSE returns are trending together. So we reject this hypothesis of no cointegration between ASE and SSE.

(5-5-2) Multivariate Cointegration

The main hypothesis is "there is no co-integration between ASE market and regional stock markets". Table 4-5 shows the results, which allow us to reach the conclusion that the four regional stock exchanges from Arab countries (Jordan, Saudi Arabia, Kuwait and Bahrain) are integrated. The trace tests indicate cointegrating at the 5% level, and the Maximum Eigenvalue test, also indicate the same result. Therefore, both tests indicate that all four countries are moving together. In addition, we reject the main hypothesis.

Table 5-5. Multivariate Cointegration Results

	Trace test		Maximum eigenvalue test	
NO. of CE(s)	Trace statistic	probability	Max-Eigen statistic	Probability
None (r=0)	115.97	0.0000	51.28	0.0000
At most 1 (r≤1)	64.69	0.0000	35.7	0.0002
At most 1 (r≤2)	29	0.0003	21.87	0.0026
At most 1 (r≤3)	7.13	0.0076	7.13	0.0076

*MacKinnon-Haug-Michelis (1999) probabilities.

From the individual investor's point of view, it implies that there is little risk diversification to be gained in investing in more than one of these markets, since they are all driven by the same factors.

It is important to note that co-integration reflects only co-movements between two time series over a period of time among variable under study but does not represent the correlation among them. Hence, through the co-integration tests, one can conclude that by and large stock price indices across the world move together. There is a need to capture the degree and the direction of correlation among the stock price indices under study.

Our results contradict those of Chen, Firth, and Rui (2002), and Click and Plummer (2005) in the context of emerging economies. Chen, Firth, and Rui (2002) examine the stock market indices of Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. They find that there is only one cointegrating relationship. Click and Plummer (2005) analyzed the five stock markets in the original Association of Southeast Asian Nations countries (ASEAN-5), and found that these markets are cointegrated; there is also one cointegrating relationship. Also, our results are consistent with those of Chung and Liu (1994) in the context of investigate the U.S., Japan, Taiwan, Hong Kong, Singapore, and South Korea. They found 4 co-integrating vectors.

Chapter Six

Conclusions and Recommendations

Chapter Six

Conclusions and Recommendations

(6-1) Conclusions

This study has investigated the relationship between Amman Stock Exchange (ASE) with other Arab markets in the region (Saudi Arabia (SSE), Kuwait Stock Exchange (KSE) and Bahrain Stock Exchange (BSE)), by examining the stock prices for these markets, during the period from January 1, 2003 through December 31, 2007. For achieving this purpose Johansen Cointegration Test, both bivariate and multivariate cointegration approaches are used in the analysis.

This study is built on our main hypothesis and broken into three sub-hypotheses. The main hypothesis is to examine the cointegration between ASE and regional stock markets, obtained by using the multivariate approach and show that the four Arab markets (ASE, SSE, KSE & BSE) in the region are cointegrated,

and that they share four long-term equilibrium relationships. The sub-hypotheses had examined the cointegration between ASE and each of the three Arab markets (SSE, KSE & BSE) in the region individually, where obtained by using bivariate approach and show that the Jordanian market is individually cointegrated with each of these three Arab markets in the region by share two long-term equilibrium relationships.

Our findings have some implications for international portfolio diversification. Overall, the results suggest that investing in several Arab stock markets may offer limited opportunity for further long-term risk diversification. The ASE compares favorably with many other Arab markets in terms of investment restrictions, transparency, and the regulatory environment.

(6-2) Recommendations

1. Analysis showed that ASE market is cointegrated to each of those regional Arab markets (SSE, KSE & BSE), but the cointegration determines whether the markets have along-run relationship or not, but coefficient in cointegration vector can tell us how the stock markets are related in the long-run, as was done by Click and Plummer (2005). So it is recommended to be taken into account in the portfolio selection process.
2. Analysis showed that stock returns for all four markets are stationary. Also this fact may be taken into account in the portfolio selection process.
3. The fact that the ASE is cointegrated with the three Arab markets could be due to the fact that global investors see these markets as close substitutes, and the analysis shows that they are. Jordan should thus continue enhancing the transparency and the effectiveness of regulation and supervision of its capital markets so as to distinguish itself further from other markets.

This would be important, as Jordan will likely rely on foreign capital inflows in the foreseeable future. Moreover, it would tend to reduce any potential contagion from adverse regional developments.

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Appendices

Appendix1: Monthly Return for the 4 Indices

	ASE	BSE	KSE	SSE
1 February 2003	-5.00809	-3.389879	7.3439057	-2.80525
1 March 2003	3.89208	-0.2154108	11.130448	8.144603
1 April 2003	7.51015	2.2241147	20.254046	5.261775
1 May 2003	4.000617	3.3623947	8.1232817	10.30243
1 June 2003	5.427097	3.9821557	-3.8996842	11.96823
1 July 2003	8.627835	2.1180712	3.1165576	8.157182
1 August 2003	4.44851	0.3795234	6.4957865	9.293428
1 September 2003	4.078427	6.176031	10.565827	0.135808
1 October 2003	-2.70854	5.2876095	0.6376878	-6.375
1 November 2003	11.08549	1.3095903	3.0656668	6.54034
1 December 2003	1.9978	3.7879258	6.0617453	4.027156
1 January 2004	7.935269	8.1147191	7.1602827	3.305405
1 February 2004	0.868179	0.4289737	1.5624696	4.985101
1 March 2004	-4.17003	0.0812947	-5.2111273	7.683693
1 April 2004	-2.26556	2.3067551	2.0696904	5.843989
1 May 2004	1.834209	1.5832324	4.5960396	3.229811
1 June 2004	2.943018	0.3576799	3.2865716	0.884924
1 July 2004	4.325891	1.1569964	4.092967	7.845622
1 August 2004	-0.46987	9.117482	3.9707695	2.12354
1 September 2004	5.720193	0.1165989	2.7114912	4.799762
1 October 2004	11.99478	4.9541613	1.0421132	11.61295
1 November 2004	19.49942	-0.2145337	3.9002578	13.18311
1 December 2004	3.400609	1.1473998	0.6706666	-1.48229
1 January 2005	17.21702	5.4768415	1.5164989	0.313299
1 February 2005	0.984608	7.8223638	3.6070512	10.49923
1 March 2005	9.726202	3.0240986	16.727979	15.4243
1 April 2005	23.55651	6.2965262	9.9388748	7.117549
1 May 2005	-2.28961	-1.6559679	-4.0607083	6.874375
1 June 2005	10.77448	-1.1300865	6.16152	11.9395
1 July 2005	8.586112	-3.0388528	1.8362784	-1.97514
1 August 2005	1.890633	-0.2511308	7.4578462	12.6484
1 September 2005	-3.85082	1.6583628	6.129243	1.162667
1 October 2005	5.483678	3.9700729	12.090919	3.90347
1 November 2005	9.202083	1.98211	3.474099	4.44692
1 December 2005	-9.35397	-1.9364405	-3.5723012	2.461696
1 January 2006	4.138436	6.7538027	3.5875615	12.53512
1 February 2006	-11.4296	-3.3509663	-2.6383933	3.695636
1 March 2006	-6.42975	-5.6348348	-14.261581	-12.523
1 April 2006	-0.42576	-1.2989443	3.4183112	-23.5457

1 May 2006	-1.71743	-3.9907683	-3.0708354	-14.1213
1 June 2006	-12.4836	1.0000444	0.8184906	17.35289
1 July 2006	-2.05945	0.5766872	-5.7479079	-17.4763
1 August 2006	5.244254	6.7561723	2.5777023	2.433179
1 September 2006	-2.5155	1.7027688	98.270941	2.68307
1 October 2006	0.382953	-0.1727518	-45.414859	-14.8304
1 November 2006	-8.18488	-2.2456244	-6.7870623	-14.3391
1 December 2006	-1.5978	1.7019266	3.2003444	-4.6987
1 January 2007	11.37348	-2.9545721	-3.532193	-11.2446
1 February 2007	6.476073	-0.3643021	0.4201075	16.1215
1 March 2007	-6.03634	0.7256718	4.8099994	-6.24067
1 April 2007	-2.89167	-2.4576577	4.7849184	-3.16366
1 May 2007	-2.34136	9.6886125	7.2683646	0.930548
1 June 2007	-1.19188	4.2608436	5.5912893	-6.97936
1 July 2007	-1.34338	6.6742208	3.4479916	8.096882
1 August 2007	-1.25611	-1.6131856	1.0844622	9.197178
1 September 2007	2.045326	0.605471	1.2817178	-4.78366
1 October 2007	16.77142	4.1109783	-0.635862	10.05985
1 November 2007	4.42421	-1.4158958	-5.600376	9.777358
1 December 2007	7.663121	5.5254692	3.7852639	18.08419

Appendix2: Johansen Cointegration Test (Multivariate)

Date: 08/11/10 Time: 10:30
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: ENDBA ENDJO ENDKU ENDSA
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.593266	115.9711	47.85613	0.0000
At most 1 *	0.465452	64.69411	29.79707	0.0000
At most 2 *	0.318603	28.99310	15.49471	0.0003
At most 3 *	0.117539	7.127306	3.841466	0.0076

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.593266	51.27694	27.58434	0.0000
At most 1 *	0.465452	35.70101	21.13162	0.0002
At most 2 *	0.318603	21.86579	14.26460	0.0026
At most 3 *	0.117539	7.127306	3.841466	0.0076

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

ENDBA	ENDJO	ENDKU	ENDSA
0.183528	0.091479	-0.087192	-0.102183
-0.066336	-0.124907	-0.075377	0.115228
-0.389171	0.111615	0.004869	-0.009526
-0.062577	-0.092460	0.028440	-0.089067

Unrestricted Adjustment Coefficients (alpha):

D(ENDBA)	-0.058966	0.779108	1.786307	0.720754

D(ENDJO)	-0.640629	2.854717	-1.876529	1.838775
D(ENDKU)	11.49044	8.141183	1.617494	-0.433307
D(ENDSA)	5.857606	-2.763168	0.283176	1.697345

1 Cointegrating Equation(s): Log likelihood -785.6580

Normalized cointegrating coefficients (standard error in parentheses)

ENDBA	ENDJO	ENDKU	ENDSA
1.000000	0.498446	-0.475086	-0.556767
	(0.13276)	(0.07204)	(0.10984)

Adjustment coefficients (standard error in parentheses)

D(ENDBA)	-0.010822
	(0.10196)
D(ENDJO)	-0.117574
	(0.19506)
D(ENDKU)	2.108823
	(0.40038)
D(ENDSA)	1.075038
	(0.20670)

2 Cointegrating Equation(s): Log likelihood -767.8075

Normalized cointegrating coefficients (standard error in parentheses)

ENDBA	ENDJO	ENDKU	ENDSA
1.000000	0.000000	-1.055217	-0.131846
		(0.13469)	(0.18012)
0.000000	1.000000	1.163880	-0.852492
		(0.19302)	(0.25811)

Adjustment coefficients (standard error in parentheses)

D(ENDBA)	-0.062505	-0.102710
	(0.10631)	(0.08434)
D(ENDJO)	-0.306945	-0.415178
	(0.19218)	(0.15247)
D(ENDKU)	1.568766	0.034243
	(0.36298)	(0.28798)
D(ENDSA)	1.258336	0.880987
	(0.20641)	(0.16376)

3 Cointegrating Equation(s): Log likelihood -756.8746

Normalized cointegrating coefficients (standard error in parentheses)

ENDBA	ENDJO	ENDKU	ENDSA
1.000000	0.000000	0.000000	-0.199439
			(0.06614)
0.000000	1.000000	0.000000	-0.777938

			(0.11832)
0.000000	0.000000	1.000000	-0.064056
			(0.18244)

Adjustment coefficients (standard error in parentheses)

D(ENDBA)	-0.757684	0.096669	-0.044888
	(0.21068)	(0.09236)	(0.05583)
D(ENDJO)	0.423345	-0.624627	-0.168461
	(0.41319)	(0.18114)	(0.10948)
D(ENDKU)	0.939285	0.214780	-1.607659
	(0.80375)	(0.35237)	(0.21298)
D(ENDSA)	1.148132	0.912594	-0.301076
	(0.46015)	(0.20173)	(0.12193)

Appendix3: Johansen Cointegration Test (Bivariate)
ASE & BSE

Date: 08/11/10 Time: 10:51
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: ENDJO ENDBA
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.311915	34.59041	15.49471	0.0000
At most 1 *	0.207852	13.28138	3.841466	0.0003

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.311915	21.30903	14.26460	0.0033
At most 1 *	0.207852	13.28138	3.841466	0.0003

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

ENDJO	ENDBA
-0.115537	0.382808
0.149144	0.137299

Unrestricted Adjustment Coefficients (alpha):

D(ENDJO)	2.030203	-3.176651
D(ENDBA)	-1.727410	-1.143372

1 Cointegrating Equation(s): Log likelihood -346.2275

Normalized cointegrating coefficients (standard error in parentheses)

ENDJO	ENDBA
1.000000	-3.313279
	(0.68285)

Adjustment coefficients (standard error in parentheses)

D(ENDJO)	-0.234565
	(0.12049)
D(ENDBA)	0.199581
	(0.05694)

Appendix4: Johansen Cointegration Test (Bivariate)
ASE & KSE

Date: 08/11/10 Time: 10:54
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: ENDJO ENDKU
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.515659	55.28103	15.49471	0.0000
At most 1 *	0.217199	13.95800	3.841466	0.0002

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.515659	41.32303	14.26460	0.0000
At most 1 *	0.217199	13.95800	3.841466	0.0002

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

ENDJO	ENDKU
-0.014475	0.110981
0.181331	-0.010625

Unrestricted Adjustment Coefficients (alpha):

D(ENDJO)	-0.747929	-3.602532
D(ENDKU)	-14.43114	0.381110

1 Cointegrating Equation(s): Log likelihood -429.0112

Normalized cointegrating coefficients (standard error in parentheses)

ENDJO	ENDKU
1.000000	-7.667047
	(1.00966)

Adjustment coefficients (standard error in parentheses)

D(ENDJO)	0.010826
	(0.01544)
D(ENDKU)	0.208892
	(0.02786)

Appendix5: Johansen Cointegration Test (Bivariate) ASE & SSE

Date: 08/11/10 Time: 11:01
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments
Trend assumption: Linear deterministic trend
Series: ENDKU ENDSA
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.511246	53.33081	15.49471	0.0000
At most 1 *	0.197266	12.52475	3.841466	0.0004

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.511246	40.80606	14.26460	0.0000
At most 1 *	0.197266	12.52475	3.841466	0.0004

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

ENDKU	ENDSA
-0.107925	-0.010202
0.035389	-0.150391

Unrestricted Adjustment Coefficients (alpha):

D(ENDKU)	14.04123	-0.626253
D(ENDSA)	2.629153	4.141746

1 Cointegrating Equation(s): Log likelihood -439.9269

Normalized cointegrating coefficients (standard error in parentheses)

ENDKU	ENDSA
1.000000	0.094531
	(0.18179)

Adjustment coefficients (standard error in parentheses)

D(ENDKU)	-1.515404
	(0.20460)
D(ENDSA)	-0.283752
	(0.14340)

Appendix6: Augmented Dickey–Fuller Unit Root Test (BSE)

Null Hypothesis: ENDBA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.782232	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDBA)
Method: Least Squares
Date: 08/11/10 Time: 11:09
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDBA(-1)	-0.893470	0.131737	-6.782232	0.0000
C	1.624064	0.504979	3.216102	0.0022

R-squared	0.450973	Mean dependent var	0.153713
Adjusted R-squared	0.441169	S.D. dependent var	4.646325
S.E. of regression	3.473360	Akaike info criterion	5.361996
Sum squared resid	675.5967	Schwarz criterion	5.433046
Log likelihood	-153.4979	Hannan-Quinn criter.	5.389671
F-statistic	45.99867	Durbin-Watson stat	2.020035
Prob(F-statistic)	0.000000		

Appendix7: Augmented Dickey–Fuller Unit Root Test D(BSE)

Null Hypothesis: D(ENDBA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.80807	0.0000
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDBA,2)
Method: Least Squares
Date: 08/11/10 Time: 11.11
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDBA(-1))	-1.513540	0.118171	-12.80807	0.0000
C	0.118502	0.538515	0.220053	0.8266

R-squared	0.748912	Mean dependent var	0.066086
Adjusted R-squared	0.744347	S.D. dependent var	8.040758
S.E. of regression	4.065582	Akaike info criterion	5.677448
Sum squared resid	909.0927	Schwarz criterion	5.749134
Log likelihood	-159.8073	Hannan-Quinn criter.	5.705308
F-statistic	164.0466	Durbin-Watson stat	2.198802
Prob(F-statistic)	0.000000		

Appendix8: Phillips–Perron Unit Root Test (BSE)

Null Hypothesis: ENDBA has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.802663	0.0000
Test critical values:	1% level	-3.548208	
	-5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11.64822
HAC corrected variance (Bartlett kernel)	12.25007

Phillips-Perron Test Equation
Dependent Variable: D(ENDBA)
Method: Least Squares
Date: 08/11/10 Time: 12:03
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDBA(-1)	-0.893470	0.131737	-6.782232	0.0000
C	1.624064	0.504979	3.216102	0.0022

R-squared	0.450973	Mean dependent var	0.153713
Adjusted R-squared	0.441169	S.D. dependent var	4.646325
S.E. of regression	3.473360	Akaike info criterion	5.361996
Sum squared resid	675.5967	Schwarz criterion	5.433046
Log likelihood	-153.4979	Hannan-Quinn criter.	5.389671
F-statistic	45.99867	Durbin-Watson stat	2.020035
Prob(F-statistic)	0.000000		

Appendix9: Phillips–Perron Unit Root Test D(BSE)

Null Hypothesis: D(ENDBA) has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-22.46966	0.0001
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	15.94899
HAC corrected variance (Bartlett kernel)	3.272834

Phillips-Perron Test Equation
Dependent Variable: D(ENDBA,2)
Method: Least Squares
Date: 08/11/10 Time: 12:07
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDBA(-1))	-1.513540	0.118171	-12.80807	0 0000
C	0.118502	0.538515	0.220053	0 8266

R-squared	0.748912	Mean dependent var	0.066086
Adjusted R-squared	0.744347	S.D. dependent var	8.040758
S.E. of regression	4.065582	Akaike info criterion	5.677448
Sum squared resid	909.0927	Schwarz criterion	5.749134
Log likelihood	-159.8073	Hannan-Quinn criter.	5.705308
F-statistic	164.0466	Durbin-Watson stat	2.198802
Prob(F-statistic)	0.000000		

Appendix10: Augmented Dickey–Fuller Unit Root Test (ASE)

Null Hypothesis: ENDJO has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.173531	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDJO)
Method: Least Squares
Date: 08/11/10 Time: 12:11
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDJO(-1)	-0.803691	0.130183	-6.173531	0.0000
C	2.377988	1.000048	2.377875	0.0209

R-squared	0.404967	Mean dependent var	0.218469
Adjusted R-squared	0.394342	S.D. dependent var	9.168146
S.E. of regression	7.135022	Akaike info criterion	6.801782
Sum squared resid	2850.878	Schwarz criterion	6.872832
Log likelihood	-195.2517	Hannan-Quinn criter.	6.829457
F-statistic	38.11248	Durbin-Watson stat	2.047318
Prob(F-statistic)	0.000000		

Appendix10: Augmented Dickey–Fuller Unit Root Test D(ASE)

Null Hypothesis: D(ENDJO) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.648673	0.0000
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDJO,2)
Method: Least Squares
Date: 08/11/10 Time: 12:13
Sample (adjusted): 2003M05 2007M12
Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDJO(-1))	-2.105331	0.218199	-9.648673	0.0000
D(ENDJO(-1),2)	0.394089	0.126377	3.118355	0.0029
C	0.162759	0.993207	0.163872	0.8705

R-squared	0.795005	Mean dependent var	-0.006771
Adjusted R-squared	0.787269	S.D. dependent var	16.09432
S.E. of regression	7.423148	Akaike info criterion	6.899167
Sum squared resid	2920.466	Schwarz criterion	7.007668
Log likelihood	-190.1767	Hannan-Quinn criter.	6.941232
F-statistic	102.7712	Durbin-Watson stat	2.149378
Prob(F-statistic)	0.000000		

Appendix11: Phillips-Perron Unit Root Test (ASE)

Null Hypothesis: ENDJO has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.418157	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	49.15308
HAC corrected variance (Bartlett kernel)	65.58851

Phillips-Perron Test Equation
Dependent Variable: D(ENDJO)
Method: Least Squares
Date: 08/11/10 Time: 12:17
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDJO(-1)	-0.803691	0.130183	-6.173531	0.0000
C	2.377988	1.000048	2.377875	0.0209

R-squared	0.404967	Mean dependent var	0.218469
Adjusted R-squared	0.394342	S.D. dependent var	9.168146
S.E. of regression	7.135022	Akaike info criterion	6.801782
Sum squared resid	2850.878	Schwarz criterion	6.872832
Log likelihood	-195.2517	Hannan-Quinn criter.	6.829457
F-statistic	38.11248	Durbin-Watson stat	2.047318
Prob(F-statistic)	0.000000		

Appendix12: Phillips–Perron Unit Root Test D(ASE)

Null Hypothesis: D(ENDJO) has a unit root
Exogenous: Constant
Bandwidth: 18 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-24.53604	0 0001
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	61.77404
HAC corrected variance (Bartlett kernel)	10.86564

Phillips-Perron Test Equation
Dependent Variable: D(ENDJO,2)
Method: Least Squares
Date: 08/11/10 Time: 12:20
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDJO(-1))	-1.499551	0.115707	-12.95985	0.0000
C	0.148824	1.059967	0.140404	0.8889

R-squared	0.753316	Mean dependent var	-0.099320
Adjusted R-squared	0.748831	S.D. dependent var	15.96527
S.E. of regression	8.001273	Akaike info criterion	7.031536
Sum squared resid	3521.120	Schwarz criterion	7.103222
Log likelihood	-198.3988	Hannan-Quinn criter.	7.059395
F-statistic	167.9577	Durbin-Watson stat	2.395567
Prob(F-statistic)	0.000000		

Appendix13: Augmented Dickey–Fuller Unit Root Test (KSE)

Null Hypothesis: ENDKU has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.982302	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDKU)
Method: Least Squares
Date: 08/11/10 Time: 12:27
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDKU(-1)	-1.279920	0.128219	-9.982302	0.0000
C	4.725719	1.993404	2.370678	0.0212

R-squared	0.640210	Mean dependent var	-0.061356
Adjusted R-squared	0.633785	S.D. dependent var	24.34982
S.E. of regression	14.73546	Akaike info criterion	8.252265
Sum squared resid	12159.49	Schwarz criterion	8.323315
Log likelihood	-237.3157	Hannan-Quinn criter.	8.279940
F-statistic	99.64636	Durbin-Watson stat	2.124916
Prob(F-statistic)	0.000000		

Appendix14: Augmented Dickey–Fuller Unit Root Test D(KSE)

Null Hypothesis: D(ENDKU) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.130426	0.0000
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDKU,2)
Method. Least Squares
Date: 08/11/10 Time: 12:28
Sample (adjusted): 2003M06 2007M12
Included observations: 55 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDKU(-1))	-3.006321	0.369762	-8.130426	0.0000
D(ENDKU(-1),2)	1.033986	0.269796	3.832466	0.0003
D(ENDKU(-2),2)	0.307224	0.132978	2.310340	0.0250
C	-0 725290	2.402110	-0.301939	0.7639

R-squared	0.845849	Mean dependent var	0.391207
Adjusted R-squared	0.836781	S.D. dependent var	44.05739
S.E. of regression	17.79933	Akaike info criterion	8.666146
Sum squared resid	16157.63	Schwarz criterion	8.812134
Log likelihood	-234.3190	Hannan-Quinn criter.	8.722601
F-statistic	93.28150	Durbin-Watson stat	2.156588
Prob(F-statistic)	0.000000		

Appendix15: Phillips–Perron Unit Root Test (KSE)

Null Hypothesis: ENDKU has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.93826	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	209.6464
HAC corrected variance (Bartlett kernel)	72.03331

Phillips-Perron Test Equation
Dependent Variable: D(ENDKU)
Method: Least Squares
Date: 08/11/10 Time: 12:28
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDKU(-1)	-1.279920	0.128219	-9.982302	0.0000
C	4.725719	1.993404	2.370678	0.0212

R-squared	0.640210	Mean dependent var	-0.061356
Adjusted R-squared	0.633785	S.D. dependent var	24.34982
S.E. of regression	14.73546	Akaike info criterion	8.252265
Sum squared resid	12159.49	Schwarz criterion	8.323315
Log likelihood	-237.3157	Hannan-Quinn criter.	8.279940
F-statistic	99.64636	Durbin-Watson stat	2.124916
Prob(F-statistic)	0.000000		

Appendix16: Phillips–Perron Unit Root Test D(KSE)

Null Hypothesis: D(ENDKU) has a unit root
Exogenous: Constant
Bandwidth: 56 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-75.97359	0.0001
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	406.5347
HAC corrected variance (Bartlett kernel)	8.362769

Phillips-Perron Test Equation
Dependent Variable: D(ENDKU,2)
Method: Least Squares
Date: 08/11/10 Time: 12:30
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDKU(-1))	-1.561021	0.111804	-13.96216	0.0000
C	-0.256267	2.718857	-0.094255	0.9252

R-squared	0.779949	Mean dependent var	0.098230
Adjusted R-squared	0.775948	S.D. dependent var	43.36412
S.E. of regression	20.52603	Akaike info criterion	8.915722
Sum squared resid	23172.48	Schwarz criterion	8.987408
Log likelihood	-252.0981	Hannan-Quinn criter.	8.943581
F-statistic	194.9420	Durbin-Watson stat	2.525036
Prob(F-statistic)	0.000000		

Appendix17: Augmented Dickey–Fuller Unit Root Test (SSE)

Null Hypothesis: ENDSA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.903140	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDSA)
Method: Least Squares
Date: 08/11/10 Time: 12:31
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDSA(-1)	-0.788771	0.133619	-5.903140	0.0000
C	2.432991	1.233454	1.972502	0.0535

R-squared	0.383579	Mean dependent var	0.360163
Adjusted R-squared	0.372572	S.D. dependent var	11.36849
S.E. of regression	9.005018	Akaike info criterion	7.267315
Sum squared resid	4541.060	Schwarz criterion	7.338365
Log likelihood	-208.7521	Hannan-Quinn criter.	7.294991
F-statistic	34.84706	Durbin-Watson stat	1.976594
Prob(F-statistic)	0.000000		

Appendix18: Augmented Dickey–Fuller Unit Root Test D(SSE)

Null Hypothesis: D(ENDSA) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.080075	0.0000
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ENDSA,2)
Method: Least Squares
Date: 08/11/10 Time: 12:32
Sample (adjusted): 2003M05 2007M12
Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDSA(-1))	-1.984812	0.218590	-9.080075	0.0000
D(ENDSA(-1),2)	0.362778	0.127590	2.843313	0.0063
C	0.330450	1.297250	0.254731	0.7999

R-squared	0.761982	Mean dependent var	0.199815
Adjusted R-squared	0.753000	S.D. dependent var	19.52738
S.E. of regression	9.704923	Akaike info criterion	7.435227
Sum squared resid	4991.833	Schwarz criterion	7.543728
Log likelihood	-205.1863	Hannan-Quinn criter.	7.477292
F-statistic	84.83617	Durbin-Watson stat	2.044270
Prob(F-statistic)	0.000000		

Appendix19: Phillips–Perron Unit Root Test (SSE)

Null Hypothesis: ENDSA has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.075118	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	78.29414
HAC corrected variance (Bartlett kernel)	93.21566

Phillips-Perron Test Equation
Dependent Variable: D(ENDSA)
Method: Least Squares
Date: 08/11/10 Time: 12:32
Sample (adjusted): 2003M03 2007M12
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ENDSA(-1)	-0.788771	0.133619	-5.903140	0.0000
C	2.432991	1.233454	1.972502	0.0535

R-squared	0.383579	Mean dependent var	0.360163
Adjusted R-squared	0.372572	S.D. dependent var	11.36849
S.E. of regression	9.005018	Akaike info criterion	7.267315
Sum squared resid	4541.060	Schwarz criterion	7.338365
Log likelihood	-208.7521	Hannan-Quinn criter.	7.294991
F-statistic	34.84706	Durbin-Watson stat	1.976594
Prob(F-statistic)	0.000000		

Appendix20: Phillips–Perron Unit Root Test D(SSE)

Null Hypothesis: D(ENDSA) has a unit root
Exogenous: Constant
Bandwidth: 18 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-19.60807	0.0000
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	100.9933
HAC corrected variance (Bartlett kernel)	24.11991

Phillips-Perron Test Equation
Dependent Variable: D(ENDSA,2)
Method: Least Squares
Date: 08/11/10 Time: 12:33
Sample (adjusted): 2003M04 2007M12
Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ENDSA(-1))	-1.452628	0.119719	-12.13360	0.0000
C	0.274295	1.355338	0.202382	0.8404

R-squared	0.728025	Mean dependent var	-0.046369
Adjusted R-squared	0.723080	S.D. dependent var	19.44129
S.E. of regression	10.23063	Akaike info criterion	7.523107
Sum squared resid	5756.617	Schwarz criterion	7.594793
Log likelihood	-212.4085	Hannan-Quinn criter.	7.550966
F-statistic	147.2244	Durbin-Watson stat	2.323965
Prob(F-statistic)	0.000000		